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REMARKS ON

The Insect Defoliators

OF OUR SHADE TREES.

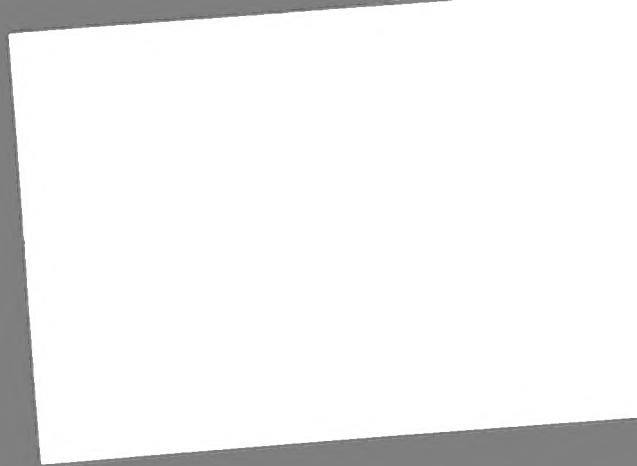
DELIVERED BY

DR. C. V. RILEY, U. S. Entomologist,

Before the New York Farmers, at a Meeting held March 10, 1867,
and Reported by James W. Tooley

♦ ♦ ♦

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AT a meeting of the New York Farmers, held March 10th, 1887, at the Hotel Brunswick, New York, Dr. C. V. Riley, having been introduced to the society by the Hon. John Jay, spoke as follows: I am afraid that I shall find some difficulty in entertaining you to-night on this subject of "Injurious Insects," for of all subjects, it seems to me, it is the most prosaic and the least calculated to excite mirth or sentiment or to form the topic of an after dinner talk.

It is always the unexpected that happens and a few days ago I little thought of being here addressing a lot of city farmers on such a subject. I was then unfamiliar with the *personnel* of the club and I am both pleased and surprised to find that there are a few persons present here to-night whom I have known before. There is my friend, Professor Lintner, who has done so much good entomological work and who is serving you so faithfully and efficiently as your State Entomologist. There is Dr. Loring whom I had the pleasure to serve under during the four years of his administration of the National Department of Agriculture which he advanced by breadth of culture and public spirit and which he graced by his presence as he does such festive boards as this before us. There is Mr. Depew whom I had the honor to journey with on a Cunarder in 1884 and who, I am glad to see, does not find politics, railroads and farming antagonistic, at least in post prandian hours, and who will, let us hope, be induced to bring in Momus to offset the sad and dreary current of what I may say.

The subject of "Injurious Insects" is a vast one, and cannot be properly dealt with in the limited space that will be at my command. I have been somewhat puzzled even to know just what to say—just what insects to talk about among the multitude that are injurious to our crops. Informed by Mr. Pellew, through whom your President urged me to be present, that I should be at liberty to choose my own subject I came prepared to talk a little upon the relation of insects and flowers, thinking that that subject might interest you as much as any other, since you all have something to do with flowers and there is a very interesting and fascinating connection between them and insects. But upon consulting a little with Mr. Jay and hearing the opinions of one or two others, I have learned that perhaps you expect, and will be more interested in, some remarks upon the insects that injuriously affect the trees that are ordinarily used as city shade trees, especially as I understand that Prof. Lintner will follow on the insects injurious to fruit trees. For that reason I will take a few of these for a text, and may premise that there is not a single insect that would not occupy

more than half-an-hour to be properly treated of in all its habits and phases. I shall, therefore, confine myself to those more particularly that defoliate the trees, leaving out of view the borers and those that affect the root and the branch and the blossom. By way of introduction, and assuming that most of you are neophytes in economic entomology, let me state a few general truths. As I have elsewhere written, insects play a most important part in the economy of nature. The average townsman, accustomed only to troublesome household pests, can scarcely appreciate their numbers, their diversity in form and habit, or their importance. As scavengers and pollenizers of our plants and fruits, they not only vitally concern man, but, philosophically considered, are essential to his very existence. They supply us with the sweetest of sweets, our very best inks and dyes, our finest robes, lace and waxes, to say nothing of their use as food (and few who have not studied the subject have any just idea of the importance of insects and their products as articles of food!) But the benefits which man derives from insects must always appear trifling compared with the injury they inflict on our agriculture. In the primitive condition of vegetation, as the hand of man first found it, insects took their proper place in the economy of nature and rarely preponderated in any direction to the injury of the wild plants, scattered, for the most part, sparsely throughout their range. Harmony between organisms, in the sense of the widest inter-relation and inter-dependence, had resulted in the long course of ages. But civilized man violated this primitive harmony. His agriculture, which is essentially the encouragement and cultivation in large tracts of one species of plant to the exclusion of others, which he denominates weeds, gave exceptional facilities to the multiplication of insects, which naturally feed on such plants. In addition to this, many others have been unwittingly imported from other countries, chiefly through commerce; for it is a most significant fact, that the worst weeds and the worst insect pests of American agriculture are importations from Europe. Thus, in addition to the undue increase of our native species, we have to contend with these introduced foreigners, for, as compared with Europe, America, as your own Dr. Asa Fitch long since remarked, is the land of insects. Insects probably outnumber in species all other animals combined, some 350,000 having already been described, and fully as many more remaining yet to be—I won't say discovered, but—characterized. And the proper and conscientious characterization of some species of microscopic insect involves as much labor as of one of the higher animals. Of the above number a good proportion are injurious to vegetation. Our associate on my left, Mr. Lintner, has estimated that there are 156 species that attack the apple alone, in one part of the tree or the other, either the fruit, blossom, trunk, branch or the root.

Let me now keep more strictly to my text. The insect defoliators of our shade trees consist chiefly of four species. They are: 1st. The imported Elm leaf-beetle (*Galeruca xanthemelæna*). 2d. The so-called Bag Worm with the very long name of (*Thyridopteryx ephemeraeformis*), sometimes called also the Drop Worm; 3d. The White-marked Tussock-moth (*Orgyia leucostigma*), and 4th, the Tall Web-worm (*Hyphantria cunea*). I will briefly

give you the principal facts connected with these four insects, though it is very difficult to do so intelligently without diagrams. No. 1, the imported Elm leaf-beetle is a little yellowish beetle, with two stripes on the elytra, and which you all probably know from appearance. It is not more than one-fifth to one-eighth of an inch in length. It winters over as a beetle, hibernating in all sorts of sheltered places, in the holes of trees, in our posts and fences, under the loose bark of trees, in outhouses, in barns, in bedrooms even—any sheltered situation that it can find, and also under the leaves of our forest trees to a very limited extent. As soon as spring opens, it leaves its winter retreat, takes to wing, for both sexes are winged, and speeds to the trees on which it feeds and on which it lays its eggs. These trees are exclusively the elms and it is very partial to the European elm. The female lays her eggs upon either the upper or under side of the leaf, but chiefly on the under side, in a double row of from 15 to 20 eggs each, each egg being yellowish elongate and pointed at free end. From these eggs there hatch the larva or worms which feed upon the trees, eating at first the mere epidermis, leaving the parenchyma, and causing the leaves to look rusty and sere,—and finally, as they grow older, eating holes through the leaves. We all know the appearance of elms that are infested or injured by these pests. The beetle, as well as the larva, feeds on the leaf, but it is the larva that chiefly does the damage. This insect is multiple-brooded, i. e., produces several generations during the year, so that its work can be seen throughout most of the summer months, and from the middle of May to the end of the growing season is noticeable. The larva descends from the tree chiefly by crawling down the trunk, but sometimes lets itself drop, and transforms at the surface of the ground or just underneath the ground to a pale yellowish pupa, naked, without cocoon, and in a couple of weeks becomes a beetle. These beetles lay eggs for another generation and so on. This species is an importation from abroad and did not originally occur in this country. Insect No. 2, the Bag Worm has a very interesting life-history, and an hour might profitably be given to it alone. During the winter season, there may be noticed hanging from the bare branches of our trees the weather-beaten cases or bags of this insect. If you cut them open, you will find the great proportion of them empty, but some will contain eggs—a brown shell filled with eggs and the eggs interspersed with a fine soft silken down. These eggs hatch, as soon as the leaves put forth, into young active worms or caterpillars. The first thing the young worm does upon hatching is to begin to make a house for itself, and it is a most amusing thing to watch it at this work. First of all, it spins a belt of silk, and after having formed the belt it gets over on the further side of the belt, puts its head under the belt and makes a perfect somersault, bends up and loosens the belt and then spins a second belt, extends the ends and finally joins them so as to form a circle. It then forces this ring of silk round the neck and by spinning more and more silk to the base at last pushes the little ring of silk up until it has formed a perfect cone. As soon as that is formed, it begins feeding. The cone is carried upright for some time, but as the worm increases in size, the bag or cone becomes too heavy and is allowed to drop.

Not to be too particular as to details, this worm in time acquires full growth, seals up its bag and fastens it securely to the tree or branch, so as not to be carried down to the ground by the fall of the leaf. Here the worm transforms to the pupa state. The male pupa is small, shows evidence of future wings, and in due course of time, an active four winged moth, black-bodied and glossy-winged, issues from the end of the silken bag. The female pupa shows no trace of wings and in fact the perfect female is a wingless and legless creature of very degraded character biologically speaking. She partially issues from the end of the pupa case, but remains in the bag, and the male by a telescopic provision of the genital organ is enabled to reach her within it. Fertilization takes place, and the eggs are laid in the case or puparium where they remain during the winter protected and secure. This insect is single brooded. The female is, as I have said, perfectly wingless and can never travel away from the tree on which she was born, or on which her bag or cone is first fastened.

We next come to No. 3—the White-marked Tussock-moth. This is, I believe, in this city and in most of the cities of this State, one of the worst of your shade tree insects. It is the species which produces that beautiful hairy caterpillar which you have all doubtless noticed in Central Park and which in years gone by was extremely injurious there—a beautiful creature—entomologically considered, of course—with bright, yellow brushes upon the back with longer tufts of black, and with a coral-red head and coral-red tubercles on the back. This caterpillar is hatched from eggs which have passed the winter not inside but on the outside of the cocoon, fastened to the trees—and as a rule to the trunks of the trees. The male of this species is also fully winged, the wing being brown, with a large white spot from which it gets its specific name. The female is, on the contrary, wingless, and she issues only from her cocoon to crawl on the outside of it and there lay her eggs. She covers those eggs with a substance that hardens and protects them. There are two generations every year and the second generation winters in the egg state on the outside of the cocoons, which you can see to-day plastered on the larger trees in Central Park or in the city.

The fourth insect I mentioned is the one that you seem to be most concerned about—the Fall Web Worm. Last year, there was a phenomenal increase or advent of it. It is the worm that webs the leaves and the twigs and the branches of the tree and absolutely defoliates it, causing it to present a very unsightly appearance and doing a great deal of harm. This insect hibernates, not in the egg state or in the perfect state as the three others that I have mentioned do, but in the pupa state. At the present time, it can be found in all sorts of sheltered situations within its cocoon as a chrysalis. As soon as the leaves are about full formed or in the month of May, there issue from these chrysalides certain white millers or moths. Both sexes are winged and therefore both readily fly. The female lays her eggs upon the under side of the leaf in a serrate mass. They are pale yellowish, very prettily sculptured and in a very few days hatch into young caterpillars, which are social and gregarious from the start and live within a

web, gradually increasing the web as they increase in size until they encompass the whole branch and sometimes a very large portion of a tree that is small. There are two broods of this insect, the last brood hatching in early August in the Southern States and hibernating as a chrysalis, but in the north there is some reason to believe there is only one.

Thus we have four insects concerned in defoliating our shade and park trees and they have very different habits and very different characteristics. Let me summarize. We have one, a beetle, perfectly capable in both sexes of flying, producing several generations during the year, wintering as a beetle and therefore very difficult to manage in the winter season. In fact, we can practically do nothing with it during the winter, because first, the beetles are hidden in out-of-the-way places where we cannot reach them, and, secondly, if we could destroy them within the city limits, we could not prevent them from flying in from the suburbs in the summer season. But with the bag worm, everything can be done in the winter season. There we have an insect that hibernates in the egg state in pods which are easily discerned on the branches of the bare trees. There is, therefore, no excuse for the increase of this pest, for it is a pest in the cities further south, though you are comparatively free from it in New York. In Richmond and Washington it is especially troublesome. It can be destroyed by burning or, preferably, by collecting the bags and depositing them in an open space. There are a number of parasites that affect this species and I have always urged that on pruning the twigs containing these bags, instead of being burned, they should be gathered together and left in a mass in some pasture away from trees so that the parasites which are also found in these cocoons may mature. If the bags are allowed to lay on the ground until midsummer, these parasites will issue as winged creatures and fly away to destroy other bag worms, while the young worms that hatch from the eggs, with very restricted and limited powers of locomotion must inevitably perish before they can reach any tree on which they can feed.

With the Tussock moth, much can also be done in the winter season because its cocoon and the eggs upon it are found upon the trunks of the trees and undoubtedly the brushing of the trees or the crushing of the egg masses, so far as they can be reached, may be effected very largely. I might state in addition that this insect is particularly numerous in the older States where the trees are larger. It seems to have a preference for the larger trees. It is not numerous in Washington City at present, at least on the younger trees. It is particularly abundant in Boston and in Philadelphia it is the chief insect found on trees. It is very abundant in Albany also, as Dr. Lintner knows, and has been so in Central Park. It is rather difficult to reach because it not only spins its cocoon upon the lower portions of the trunk, but all over the trunk and limbs.

The fourth species I have described, the Web-worm was, as I have said, the most destructive of all last year. Throughout the New England States and on all the Atlantic coast, it had a phenomenal increase and in Washington City, it became the "caterpillar nuisance." This can also be dealt with in some degree in the winter season. It hibernates in all sorts of sheltered

places, such as the caves of houses or in the angles of tree boxes. It can measurably be reduced by searching for and destroying the cocoons and chrysalides during the winter.

There is fortunately one remedy that applies to all four of these insects alike, and whether or not we attempt to prevent their ravages by destroying them in the winter time, we may, after they have got to work, successfully and thoroughly and economically and cheaply protect our trees by the use of the different arsenites. Every one of these four insects feeds by devouring the leaves in the larva state, and in the case of No. 1 in the beetle state as well, and they are all amenable to the same treatment—in other words the spraying of the trees with a solution of arsenic in any form will very effectually destroy all four species as soon as they hatch. Allow me to read here a few lines from Bulletin No. 10 of the Entomological Division of the Department of Agriculture, now being printed on this subject of spraying.

“From the natural history facts already given it is clear that they all begin their work very much at the same season or as soon as the leaves are fairly developed, and arsenical mixtures properly sprayed on the trees about the middle of May and repeated once or twice at intervals of a fortnight later in the season, will prove an effectual protection to trees of all kinds. This can be done at small expense, and will prove the salvation of the trees. An apparatus can be readily constructed, such as has been used on the grounds of the Department of Agriculture, on a sufficiently large scale to economize time and labor. It should consist of a water tank mounted on a cart and furnished with a strong force pump operated by one man and furnished with two sets of rubber tubing of a sufficient length (a hose reel can be constructed on top of the cart), each hose supported by a bamboo extension pole with a cyclone nozzle at tip. With such an apparatus as this three men could drive along the streets and thoroughly spray two trees simultaneously; while if it were found advisable, four independent tubes and four men to work them could be employed with a sufficiently powerful pump, and thus expedite the work. The details of the more important devices connected with this tank-cart are given in my official reports. The bamboo ‘extension pole’ is used simply to stiffen the rubber hose and to enable the operator to elevate the spraying nozzle into the center of the tree and spray to a so much greater height. The same result can be accomplished by means of a brass rod or gas pipe, in sections, and this has the advantage of superior strength, and will consequently carry a heavier nozzle or a bunch of nozzles at the end.

“The ‘cyclone’ or ‘eddy-chamber’ nozzle is better suited for work of this kind on small trees than any yet in use. It is small, simple, cheap, will not clog, and gives an admirable spray. A combination nozzle may be made of several of these which will be readily supported by the section rod and will throw a more profuse spray.

“The arsenical compound known as London purple is, as already shown, perhaps preferable to white arsenic or Paris green in that it is not so liable to burn the leaves while its color enables one to readily distinguish poisoned from non-poisoned trees. Moreover it is very cheap. From one-

quarter to three-quarters of a pound of this substance should be used to a barrel of water, and with this quantity of water it is best to mix three quarts of cheap or damaged flour which will serve both to render the mixture adhesive to the leaves and also to lessen the tendency of the poison to burn the leaves. Three-quarters of a pound to the barrel may prove too strong a mixture for delicate and susceptible young trees, and it will be best for general application to make the amount from three-eighths to one-half pound to the barrel. Paris green will require a somewhat heavier dose—say from one-half to one pound per barrel of water.”

I am now referring of course to city shade trees and my remarks apply to streets where there are long rows of trees to protect. If you only have a few trees, you need not go to the expense of a cart or tank but a mere barrel that will hold a sufficient amount of water can be used, so long as you have a force pump and the spraying attachment. This last is novel and I should like to show you how it works, but that is not practicable here. It consists of a little disc into which the water is forced tangentially by means of a force pump so as to be made to revolve at an intense rate in a cyclonic course and it issues through a central orifice on the upper portion of the disc, and is detachable, so as to permit the cleaning of any impediment or the removal of any obstruction that may get into it. Through the minute orifice a spray is formed so fine that it can be scattered on the under side of the trees without dropping and so as to prevent washing away by rains. Any respectable firm dealing in colors sell the London purple, and a pound costing not more than five cents, can be placed in 80 or 100 gallons of water and can be sprayed on the trees.

Mr. Otis: Is it absolutely necessary to use the purple or the Paris green?

Prof. Riley: Some form of arsenic.

Mr. Otis: I have been told that simply washing the trees well with water by means of a garden engine will wash the beetles off.

Prof. Riley: It is useless to wash the beetles off because other beetles will fly in. You want to kill the beetle and kill its young. One pound of arsenic and one pound of sal. soda boiled in one gallon of water till the arsenic is dissolved and diluted at the rate of one quart to 40 gallons of water will answer as well as London purple and Paris green. The chief merits of arsenic are cheapness and solubility. Its demerits are its color which makes it liable to be mistaken for harmless compounds. Paris green has been more extensively used than any other arsenical compound and is on the whole one of the most useful. The only advantage the London purple has for tree purposes is that it is of a different color to the leaf and therefore you can better judge when a tree is properly sprayed; secondly, it is cheap; thirdly, it is more soluble; and fourthly, as far as absolute experiment goes, it is really more efficient. On the Department grounds we had an excellent opportunity of testing, for we have there almost every species of elms cultivated, from the imported or European to the several indigenous varieties. The beetle shows some preferences and on one occasion I remember distinctly I took half of the trees of each species and

treated them and left the other half untouched, as an evidence to Mr. Sanders, the superintendent of the grounds, of the effect of our treatment and the trees treated were green for the first time in many years in the middle of the summer, while those not treated were destroyed. While this beetle has its preferences, yet when numerous, there is no elm absolutely free from its attacks.

Mr. Pellew : Is there any tree free from the ravages of all these four insects named ?

Prof. Riley : Oh yes. For instance, to be specific, I will say that the Elm-leaf beetle is confined to the elms and attacks no other genus of plants. The Bag worm is a very general feeder, but at the same time, it is more injurious to conifers or evergreens than to deciduous trees. The Tussock moth has a decided preference for the larger and older elms and the maples—the soft maple it is attracted to particularly, I think—and never occurs on conifers. It is fond also of the horse chestnut and several other trees that might be named. The web worm is also a very general feeder but has a great predilection for the box elder (*Acer Silgundo*) and I would never advise the planting of that tree in any city liable to its attacks. But it is not partial to the other maples. The soft, the sugar, the Norway and the silver maples are rarely affected by it. It is fond of the poplars and the willows. There are some trees that are never touched by any of these insects, but these are trees which the municipal authorities seldom think of planting. We are all creatures of habit and most of our gardeners are Scotchmen or Englishmen, who come here with the notions they imbibed at home, and they have introduced the foreign trees and have often neglected indigenous ones. Our sweet gum and tulip tree are never attacked by insects, and there are no more beautiful trees in the world, whether for autumn foliage or for general beauty of growth. There is also the sour gum and quite a number of other trees that are perfectly free from any of these four insects and that ought to be tried in preference to the trees often planted.

Mr. Dinsmore : I had some maples that had millions of pure white flies beneath the leaves.

Prof. Riley : They are probably perfectly harmless things—May flies. That is a phenomenon totally outside of the question we are considering. They will never do you any mischief. May flies feed in the larva state in water and simply come there to settle just as they do on the windows of houses.

Mr. Pellew : Do either or any of these four insects attack the ends of the boughs and bore into them so that the boughs break off ?

Prof. Riley : No, sir ; that is an entirely difficult thing. My friend, Dr. Lintner, will I hope touch on some of the fruit insects. I want to say a few words further about white-washing trees. I do not know whether that is the custom in New York City, but in Washington, the authorities, though they have never given any attention to the subject, have the idea that white-washing frees the trees from some of these insects. In reality, there is only one of the four insects that can be in any way thus affected

and that is the Tussock moth. So far as the white-washing reaches, a certain number of the cocoons will be loosened and exposed to the rains or rubbed off by the brushing, and it may possibly be that the lime will affect them though there is no evidence that such is the case. But it is of no earthly use against the Bag worm or the Elm leaf-beetle or the Web worm, and if it must be done at all, there is no reason why the authorities should not at least color the lime so as to cause it to resemble a little more nearly the color of the trunk of the tree. Of course, I will not discuss the matter from an æsthetic standpoint, yet while to some it may not be unpleasant to see a lot of trees white-washed, I for one do not like to see it. I may even add that so far as the insects I have mentioned are concerned, it is an injury. Every one of those insects, with the exception of the first has a number of enemies and parasites, many of which have been discovered but very recently. For example, up to the present year, no parasites were described or recorded as affecting the Web worm, but I now know of quite a number. Among such enemies there is the so-called wheel-bug (*Prionotus Cristatus*) a creature that is best characterized by a peculiar serrate cog-wheel on the back of its head, and that is further peculiar in using turpentine in cementing together its eggs. This creature destroys the caterpillars both of the Tussock-moth and the Web worm. Then there is the parasite, *Perilitus Communis*, an interesting point about which is that it forms a little brown cocoon, attached by a silken thread, and these cocoons are sometimes so numerous on the outside of the trunk of the trees which have been injured by this Web worm that the trees present a very marked appearance. Another point I want to make *en passant* is that the English sparrow has been noticed to peck away at these cocoons of the parasites but never to attack the caterpillar itself. The white-washing does harm in destroying some of these parasites and also in destroying the egg masses of spiders that also attack the caterpillars.

As to the tree boxes, while they may be necessary on account of the injury that without them, horses and other animals as well as mischievous boys would inflict upon the trees, at least until these have attained a certain size, they are always harmful. They injure the trees by chafing and by the pressure of the bandages, and when of wood, as they are in the city of Washington, they are particularly injurious, because they serve as nidi for different insects. If the laws cannot be made so strict as to prevent injury from horses or lads, then I would advise the use of round iron boxes.

I wish also to say a few words with reference to birds and especially in regard to the English sparrow, because there is a prevalent opinion, more or less sentimental, that the English sparrow helps us in our warfare against these defoliators. In point of fact, there is not one of the four insects mentioned but has some protection against most birds. The Elm-leaf-beetle is never attacked by birds because of an offensive odor. The Bag worm is effectually protected by its tough bag of silk. The *Orgyia* is effectually protected by its hairs and these are more or less mixed in the cocoons and the *Hyphantria* by both its hairs and web. A few native birds are known to attack the last two. The yellow-billed and black-billed cuckoos,

the screech-owl, the common robin, and the Baltimore oriole have been known to attack them occasionally, but the English sparrow, which is the bird we should look to for assistance because of its prevalence in our cities is the very bird that has never been known to attack any one of them, and I believe that it is the increase of the English sparrow that has been indirectly the cause of the increase of these insects, for by preying upon the smooth green worms which are not so troublesome and never were, they have given opportunity and room for these hairy worms to multiply. It is a very general law in nature that if you take away one species of organism you give an opportunity for another organism to take its place and in this way, the increase of the Web-worm and of other insects which the sparrow does not touch, is indirectly due to the increase of that bird in our cities. Another reason also why they are more injurious—for it is true that none of these insects are as injurious in the woods as in the cities—is the protection they get by tree boxes and the shelter of our houses.

Mr. Pellew: To what is the decrease in the measuring worm due, if not to the sparrow?

Prof. Riley: Partly to the fact that it has been effectually exterminated in all the older cities, like Boston and Cambridge, by man, who has bandaged the trunks with tar. That has been very effectual, I have no doubt, because it is just as abundant yet in orchards that have not been so treated. The second cause is probably the English sparrow. The English sparrow is said to feed on the canker worm in the breeding season. I cannot say it is so. I do not know of any absolute observations which are reliable which will give us the positive fact that the English sparrow does feed upon the canker worm, though as it is a smooth worm and has no protective property, either by odor or hairs, it is probable that the sparrow will take it. But the other and worse hairy pests have increased. In the case of the canker worm, we have an insect which was very troublesome and defoliated the trees in early spring just as soon as the leaves were out, but in the beginning of May here, or by the end of May in the New England States, it vanished, entering the ground and remaining there in the chrysalis state all through the summer, fall and the winter months until the next spring. In the case of this Tussock moth, we are troubled with it all through the growing part of the year. In other words, we have exchanged for a species which was single-brooded and which occurred only in the larva state for a limited period, a hairy caterpillar which is double brooded and occurs all through the summer and autumn and which further forms its cocoon above ground and disfigures our houses and trees by the masses of these cocoons formed upon them. I had intended to make some remarks on imported insects and on the importance of the knowledge of the habits of insects, but have already occupied too much time. I think this last however, is pretty well illustrated in connection with the insect you have asked me about—the Elm-leaf-beetle, because it is an historical fact that many years ago the city fathers of Baltimore found their elm trees being defoliated and blighted just as those in Cambridge were, and learning that the people of Cambridge were using troughs of oil around their grand elms, as a protec-

tion, went to work and ordered similar troughs to be put around their own trees. But it did not help. What was the reason? In Cambridge, the trees were suffering from the canker worm, (*Paleacrita vernata*) which in the female state is wingless and has to climb up the tree. Therefore these oil troughs or bandages of tar impeded her progress and the leaves were protected. But in Baltimore, they were troubled with the Elm-leaf-beetle with very different habits. This shows the importance of knowing just what you have to deal with and I might extend and elaborate this argument to show you how important it is to prevent the introduction of foreign pests. I have incidentally stated that all our worst pests and worst weeds are importations from Europe. Just now in Australia they are suffering from a plague of rabbits, introduced from Europe and we are almost threatened with their importation from that country although we have been free from the European rabbit as a direct importation for three centuries. It would be a greivous pest and a cargo was actually shipped to San Francisco and had to be stopped by the authorities. My friend on the right mentioned in conversation that he had such a hatred of England that he thought he would introduce the mosquito there. Alas, as I know to my sorrow, it is already colonized in some parts of London, for I never suffered more from it than in the Grosvenor Hotel. I do not know of anything that could be done to produce more injury to the United States than the introduction of some of the plagues from foreign countries that now annoy them. For instance, take the tsetse fly in Africa. If it were introduced here, it would probably be more disastrous than any army of foreign soldiers bent on war, because our stock would vanish before it just as is the case in Africa. In California to-day the fruit growers are suffering grievously from a pest (*Iceryapurchasi*) that was introduced from the southern hemisphere. It probably originated in New Zealand, was introduced from there to Australia and from Australia to Cape Colony, and from either Cape Colony or Australia to California. It is to-day more injurious to the fruits generally of California than all other insects, and if it gets east, it will prove more injurious than any we now have. You know the history of the grape phylloxera. What has not France suffered from its ravages? I strongly urged in 1871 the prevention of its introduction into California from the Eastern States or from France, but the advice was unheeded and the Napa and Sonoma valleys have suffered from it a thousand fold more than the necessary cost of officers to stop it. In Connecticut, you have to day a new pest of the pear, which seems as yet to be limited to a very small area. It is a European insect, unknown anywhere else in this country and ruins the pear crop wherever it spreads. It could be now probably suppressed if the Department of Agriculture had the power to defray the expense of suppressing it. But there is no such authority. What is the consequence? It may spread over the country just as the cabbage worm did, and just as many others of these pests are now pushing over the country. It is an important matter and you in the city of New York, the great harbor of the country can probably in the future do more to prevent the introduction and the spread westward all

over the country of foreign pests of this kind than the people of any other port or city. I do not see why, because these creatures are small in size and apparently insignificant, they should not be dealt with in the same way as the diseases of domestic animals. You do not hesitate to vote millions to exterminate pleuro pneumonia and I maintain that the introduction of foreign diseases in the way of insects is equally important, for though it does not appeal to your pocket so directly, it in the end does as much harm. The ravages of injurious insects in this country in the aggregate foot up to enormous sums and have been variously estimated at from \$300,000,000, to \$400,000,000 annually, taking the whole United States together. Past losses from introduced species have been enormous enough to justify precautionary measures.

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